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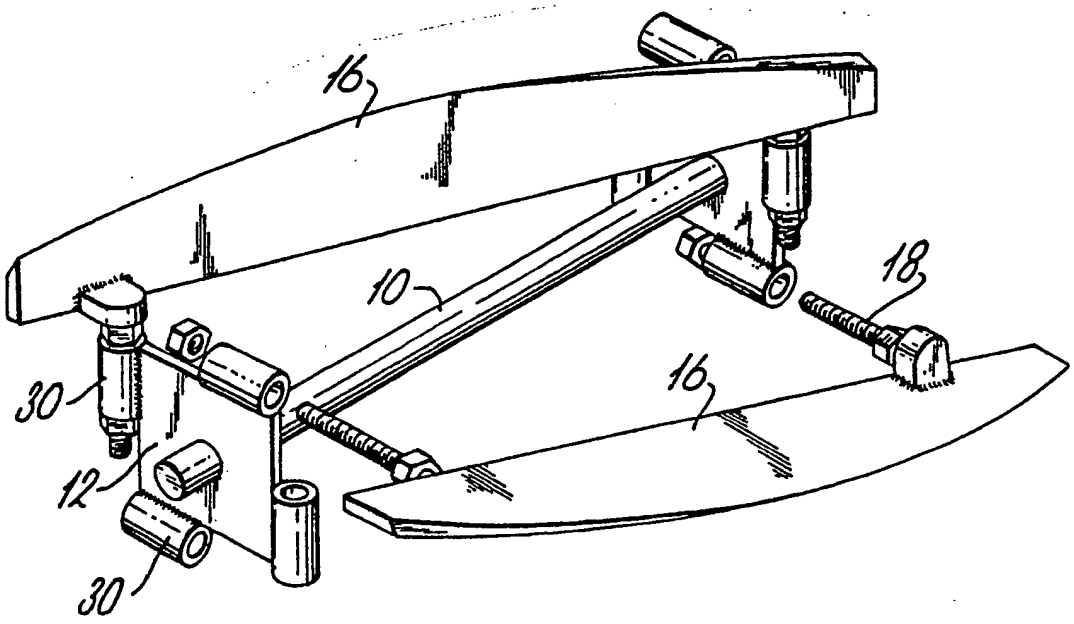

(57) Abstract

A cutter cylinder for a mower which includes a rotatable drum (10, 12, 14, 16) having a plurality of blades (16) which have respective cutting edges (12) lying on an imaginary cylindrical surface co-axial with the drum, but each blade (16) is a substantially planar member cut from sheet metal, or, in a variant, comprises two mutually inclined planar parts, formed by bending about a line in the plane of the sheet, to afford a chevron-like formation. At least some of the blades (16) may be detachably secured to the drum or may be adjustable or resiliently displaceable radially with respect to the drum axis (10).

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DESCRIPTION OF INVENTION

Cutting cylinder.

THIS INVENTION relates to mowing machines, more particularly to mowing machines of the kind utilising a cutting cylinder.

It is an object of the present invention to provide an improved cutting cylinder for a mowing machine.

It is also an object of the invention to provide a cylinder mowing machine incorporating such an improved cutter.

According to one aspect of the invention, there is provided a cutting cylinder for a mower, comprising a central structure adapted to be mounted in a mower for rotation about an axis thereof and a plurality of blades secured to said central structure and having respective cutting edges lying substantially on an imaginary cylindrical surface co-axial with said central structure, and wherein each said blade is a member cut from a planar metal sheet and is either substantially planar or comprises a plurality of substantially planar portions connected by a simple bend or bends to lie in angled relationship to each other.

According to another aspect of the invention there is provided a cutting cylinder for a mower, comprising a central structure adapted to be mounted in a mower for rotation about an axis thereof, and a plurality of blades detachably secured to said central structure and having respective cutting edges lying substantially on an imaginary cylindrical surface co-axial with said central structure.

According to another aspect of the invention there is provided a mower incorporating a cutting cylinder according to the last-noted aspect mounted for rotation about said axis thereof, the arrangement being such that individual said blades can be removed from the cylinder without removal of the cylinder from the mower.

Embodiments of the invention are described below with reference to the accompanying drawings in which:-

FIGURE 1 is a side elevation view of a blade of a mower cylinder embodying the invention,

FIGURE 2 is an edge view of the blade of Figure 1,

FIGURE 3 is an end view of the blade of Figures 1 and 2,

FIGURE 4 is an elevation view of a cutting cylinder embodying the invention incorporating a plurality of blades of the form shown in Figures 1 to 3,

FIGURE 5 is an end view of the cutting cylinder of Figure 4,

FIGURE 6 is a partially exploded perspective view of the cutting cylinder of Figures 4 and 5 with parts omitted for clarity,

FIGURES 7, 8 and 9 are fragmentary views, partly in section, illustrating different modes of mounting cutter blades in a cutting cylinder embodying the invention,

FIGURES 10 and 11 are respectively side and end elevation views of a variant mower cutting cylinder embodying the invention,

FIGURES 12 and 13 are respectively side and end elevation views of a yet further form of mower cutting cylinder embodying the invention and

FIGURES 14 and 15 are respectively side and end elevation views of a still further form of mower cutting cylinder embodying the invention.

Referring to Figure 4, a mower cutting cyclinder comprises a central shaft 10, the axis of which constitutes the axis of the cylinder, end plates 12 welded to the shaft 10 adjacent the ends thereof, central support plates 14 welded to the shaft 10 adjacent the middle thereof and a plurality (four in the embodiment illustrated) of blades 16 detachably secured to the end

plates 12 and central support plates 14.

As shown in Figures 1 to 3, each blade 16 comprises an elongate, planar piece of sheet metal. Each blade has a radially inner edge 15, (shown straight in the drawings but which may be any desired shape, for example concavely curved) and a convexly curved edge 17 which is the radially outer cutting edge of the blade in the assembled cutting cylinder. The blades 16 are so mounted relative to the shaft 10 as to extend in a quasi-helical manner around the axis of the cylinder, with the cutting edges 17 lying substantially on an imaginary cylindrical surface, coaxial with the shaft 10. The edge face of each blade 16 providing edge 17 is ground to form part of an imaginary cylindrical surface on which the cutting edges of all the blades 16 in principle lie. However, if desired, the edge face of each blade may be inclined slightly with respect to such surface. The blades 16, in use, cooperate with a stationery cutting blade (not shown) of the mower in a manner known per se.

The blades are made from flat sheet steel, the cutting edge 17 of each blade being curved to suit the required cutting diameter of the cylinder and the angle at which the blades are mounted relative to the cutting edge of the bottom blade. Each blade 16 has bolts 18 welded thereto adjacent the ends of the blade, the bolts 18 being welded on opposite faces of the blade and extending from the straight edge 15 of the blade perpendicular with the edge 15 and parallel with each other and with the planes of the major faces of the blade. In the central region of each the blade 16, slots 20 extends into the blade from the straight edge 15, substantially perpendicular with the edge 15.

In the assembled cylinder, the bolts 18 are received in respective bores in respective tubular housings 30 welded to the respective end plates 12 whilst the slots 20 receive bolts 21 which pass therethrough and through apertures formed in lugs 22 of the plates 14, the blades 16 being clamped to lugs 22 between the heads of the bolts 21 and nuts screwed onto the bolts. Each bolt 18 has screw threadedly engaged thereon a stop nut 25 which is preferably a self-locking nut, or which may have a lock nut (not shown) associated therewith, and a lock nut 27 which again is preferably a self-locking nut. As best shown in Figure 5, each bolt 18 extends entirely

through the co-axial bore of a respective housing 30 and the nuts 25 and 27 are tightly engaged with opposite end faces of the respective housing 30.

In the arrangement shown, each end plate 12 has the form of a generally square metal plate with the shaft 10 extending through its centre, the plate having at each corner thereof, on a respective edge of the plates, a respective housing 30 welded thereto, with a respective bore therethrough, to receive a bolt 18, such bore extending generally parallel with the respective edge of the plate. This arrangement allows any of the four bolts 18 secured to the plate to be removed therefrom, with its respective blade, without disturbing the other blades or bolts. The end plates 12 are turned through 180° relative to each other, about an axis perpendicular to the shaft axis, so that at opposite ends of the cutting cylinder, any particular blade 16 has its bolts 18 lying on opposite sides of the shaft axis, in conformity with the inclination of the plane of the blade to the shaft axis, the major faces of the blade, midway between the ends of the cylinder extending substantially radially with respect to the shaft axis.

Each of the central plates 14 is likewise generally square with, adjacent each corner, a respective lug bent from the sheet metal of the plate.

It will be appreciated that by slackening the nuts on the bolts 21 associated with a particular blade 16, and adjustment of the nuts 25 and 27 on the bolts 18 of that particular blade, the blade may be adjusted generally radially outwardly or inwardly with respect to the shaft 10 or the inclination of the blade with respect to shaft 10, from one end of the cutting cylinder to the other (such inclination being generally ideally zero), adjusted, whereafter the bolts 25 and 27 may be appropriately tightened and the bolts 21 tightened to hold the blade in its adjusted position. Furthermore, the blade may be removed from the remainder of the cylinder in its entirety simply by unscrewing the nuts 27, loosening the bolts 21 and withdrawing the blade radially.

In Figure 6 the central support plates have been omitted and two of the blades omitted, for clarity of illustration.

Whilst, in the arrangement shown in the drawings, the cylinder has four blades, variant cylinders may have different numbers of blades, the end plates being shaped according to the number of blades, (triangular for 3 blades, square for 4 and so on).

In a variant cylinder, each blade 16 may have, adjacent either end, a respective internally screw threaded boss 40 welded thereto, as shown in Figure 9 the axis of the screw threaded bores in the bosses 40 being arranged similarly to the axes of the bolts 18 in the embodiment of Figures 1 to 6, the bosses being provided at the free ends thereof with spigots 41 adapted to fit snugly within sockets provided by the housings 30 welded to the end plates, with the blades being held in position by bolts 42 extended through the housings 30 and into screw threaded engagement with the threaded bosses 40 to clamp the latter against the housings and thus to secure the blades 16 in their desired positions relative to the remainder of the cylinder.

In further variants, the blades 16 may be mounted with provision for limited resilient movement in the radial direction.

Thus, in the arrangement illustrated in Figure 7, each housing 30 has an enlarged bore portion extending from the end of the housing furthest from the respective blade to an internal annular shoulder adjacent the opposite end of the housing, and a reduced diameter aperture extending through said other end of the housing. In this variant, the respective bolt 18 extends through this aperture and through the enlarged bore to project from the opposite end of the boss while a compression spring 44 fitted within the enlarged bore around the bolt 18 acts between said annular shoulder and a washer 46 carried by the bolt 18 and located by the self-locking nut 27. The spacing between the stop nut 25 and the nut 27 in this case is slightly greater than that between the outer face of the washer 46 and the outer end face of the housing at the opposite end of the housing 30. The spring 44 normally acts to hold the stop nut 25 against the end face of the housing but the blade 16 is displaceable, for example by sufficient centrifugal force, against the resilience of the spring 44 to compress the latter sufficiently to allow the washer 46 to abut the adjacent end face of the housing 30, thus limiting further outward movement of the blade.

Where the bolts 18 are replaced by bosses 40, (Figure 9) a similar effect may be obtained by accommodating a compression spring 44 within the housing 30, around the bolt 42 between the free end of the spigot 41 and a washer 46 engaging the head of the bolt, if the bolt is not tightened fully.

In a further variant, shown in Figure 8, each housing 30 may have a through bore of larger diameter than the bolt 18 with a resilient rubber bush 48 being accommodated within the bore through the housing, around the bolt 18, and projecting slightly from the housing 30 at its ends, the bush being held in a compressed condition by the nuts 25 and 27 in such a manner as to allow limited displacement of the bolt 18 and the blade 16 by resilient distortion of the rubber bush.

However, where an arrangement is used permitting limited resilient displacement of the blades, it is preferred that each of the blades is provided at its leading end (i.e. the end which leads in the direction of circumferential rotation) with a mounting such as shown in Figure 8 using a rubber bush and is provided with a spring arrangement (Figure 7) at its trailing end, whereby displacement of each blade at its leading end is mainly an angular tilting movement, whilst that at the trailing end has a substantial radially outward component.

In manufacture of a mower cutting cylinder as described with reference to the drawings, the blades are fixed to the plates 12 and 14, welded to the shaft 10, as described, the nuts 25 and 27 being positioned to give substantially the desired setting of the blades. The blades are then ground in a jig to the required diameter, (this to match the designed distance between the centre of the cylinder spindle and the cutting edge of the bottom blade when assembled in the machine).

As the stop nuts 25 remain at their original setting, unless moved, when, after subsequent disassembly, the cutting cylinder is reassembled, the cutting edges of the blades are automatically set to the cutting diameter at which they were originally ground.

The blades can be moved inwards or outwards to achieve and maintain correct contact with the bottom blade by releasing the lock nuts

27, moving the stop nuts 25 as necessary, and tightening the lock nuts 27 again. The bolts 21 are, of course loosened during the adjustment process, and re-tightened afterwards.

Cylinder blades 16 can be removed and replaced or re-fitted by removing the lock nuts 27, slackening the bolts 21, and lifting the blades clear of the tubular housings 30. This will not affect those blades remaining in the cylinder assembly, and, provided the stop nuts 25 of the blades removed are not moved whilst the blades are dis-assembled, blade adjustment will automatically be correct when the cutting cylinder is reassembled.

Similarly, a replacement blade which has been pre-ground to the correct cutting diameter will automatically be correct in adjustment when fitted into the assembly.

Where cutting cylinders have an even number of blades, alternate blades can be removed, thus giving the cylinder the facility to cut longer, rougher growth than it could with all blades fitted, and the machine is thereby afforded a wider capability.

Those embodiments which permit limited resilient displacement of the blades 16 radially outwardly, such as that utilising a mounting arrangement as shown in Figure 9, can be set to give a controlled spring loaded effect to the cylinder/bottom blade contact in the assembled mower.

A centrifugally expanding capability is also given to the cylinder in such embodiments, a preferred arrangement, in such a case, being one in which the tubular housings on the leading ends of the blades are fitted with rubber bushes as shown in Figure 8, and the housings on the trailing end with return springs as shown in Figure 7. With this arrangement, as already noted, the lock nuts are unscrewed to allow slight movement of the blade at the trailing, (spring loaded) end. Consequently, centrifugal force will induce the blades to lift at their trailing ends, slightly distorting the rubber bushes and compressing the springs at the trailing ends to ensure good contact between the blades 16 and the fixed blades.

With arrangements in which the blades are intended to be capable of limited outward movement, the central support bolts 21 are tightened sufficiently to give support without impeding blade movement.

The grass mower cutting cylinder described, unlike the traditionally designed mower cutting cylinder, with rigidly fixed blades has blades which can be adjusted to take up wear and manufacturing tolerances, which can be removed or fitted to vary the number of cuts per metre of machine travel, or can be individually replaced when damaged, all without stripping the machine or the necessity of expensive regrinding of the cylinder assembly.

The blades are flat, and so can easily be made from sheet or strip material without further forming. As the blades can be individually adjusted, there is no necessity to build a facility into the machine for adjusting the complete cylinder assembly, thus reducing the number of components in the machine.

The design also affords the possibility for the cutting cylinder to be given self adjusting and centrifugally expanding facilities.

The manufacture of the individual cutting blades of the cutting cylinder as flat members cut from planar metal sheet is substantially cheaper than the manufacture of conventional cutting blades, which have a complex bent and twisted shape. Considerable savings can be effected in the manufacture of mower cutting cylinders in which in the individual blades are fixed permanently to the central structure of mower cylinder, for example by rivetting or welding, by making such individual blades as flat members, cut from planar metal sheet, i.e. of a form similar to those described in relation to the drawings, and such a construction is within the scope of the present invention.

Figures 10 and 11 illustrate a variant of the cutting cylinder of Figures 1 to 5. In this variant, the cutting blades are again flat members cut from planar metal sheets with their outer edges ground to conform with a common imaginary cylindrical surface coaxial with the mower cylinder. However, in this instance there are six blades, arranged at equal intervals around the periphery of the mower cylinder, and comprising fixed blades,

referenced 16a, which are simply welded to the support plates 12, 14 and adjustable blades 16b which are interposed between the blades 16a and are supported from the plates 12, 14 in substantially the same manner as described with reference to Figures 1 to 5. This arrangement allows the same cylinder to be used for cutting longer or shorter growth successfully, the adjustable and removable blades being detached from the cylinder for cutting longer growth and being retained on the cylinder for cutting shorter and finer growth.

Figures 12 and 13 illustrate a mower cylinder in which each of the blades has again been cut from planar metal sheet material, but in this case each blade has been bent about a line transverse to its length and lying in the plane of the original sheet material to form a shallow "V" or chevron, the fold line being midway between the ends of the blade, so that the blade comprises two portions, inclined at a small angle with respect to each other about said transverse fold line, each said portion being substantially planar. The blades are so arranged in the mower cylinder that the apices of the chevrons all point in the same circumferential direction, opposite to the direction of rotation. In the arrangements shown in Figures 12 and 13, the blades are all fixed with the plates 12, 14 for example by welding. This arrangement takes up less space and allows a larger number of blades per cylinder to be used. In the arrangement shown, the cylinder comprises ten blades.

Chevron-shaped blades formed in the same manner as described with reference to Figures 12 and 13 may be adjustably and detachably mounted in a mower cylinder, as illustrated in Figures 10A and 10B. In this arrangement, the central support plate 14 is simply provided with radial slots to receive the bends of the chevron-shaped blades, the outer plates 12 carry the adjusters for these blades in substantially the same manner as described with reference to Figures 1 to 5, whilst the plates 14 intermediate the central plate 14 and the outer plates 12 carry clamping bolts cooperating with slots 20 provided in the blades 16 in the same manner as described with reference to Figures 1 to 5.

It will be appreciated that, if desired, in a manner analgous to the

arrangement of Figures 10 and 11, some of the chevron-shaped blades may be permanently fixed and others may be made adjustable and removable.

The use of chevron-shaped blades are described with reference to Figures 12 and 13 and 14 and 15 makes it relatively easy to produce cutting cylinders which deliver the grass cuttings from the centre of the cutting width and at right angles to the cylinder axis, thus overcoming the tendency, present in mowers utilising conventional mower cylinders, for the grass cuttings to be delivered predominantly towards one end of the cylinder, and thus into one side of the cutting box used to collect the grass cuttings. Such central delivery can conventionally only be achieved by utilising a relatively complex and expensive assembly using left-handed helical blades on one side of the cutting width and right-handed helical blades on the other.

Cutting cylinders of the type described with reference to mowing machines may also be used for vegetation chopping machines, used, for example, for the mulching of vegetable waste in the preparation of compost or the like and the term "mowing machine" or "mower" as used herein is intended to be broad enough to cover such use.

CLAIMS

1. A cutting cylinder for a mower, comprising a central structure adapted to be mounted in a mower for rotation about an axis thereof and a plurality of blades secured to said central structure and having respective cutting edges lying substantially on an imaginary cylindrical surface co-axial with said central structure, and wherein each said blade is a member cut from a planar metal sheet and is either substantially planar or comprises a plurality of substantially planar portions connected by a simple bend or bends to lie in angled relationship to each other.

2. A cutting cylinder for a mower, comprising a central structure adapted to be mounted in a mower for rotation about an axis thereof, and a plurality of blades detachably secured to said central structure and having respective cutting edges lying substantially on an imaginary cylindrical surface co-axial with said central structure.

3. A mower incorporating a cutting cylinder according to claim 1 mounted for rotation about said axis thereof, the arrangement being such that individual said blades can be removed from the cylinder without removal of the cylinder from the mower.

4. A cutting cylinder according to claim 1 wherein each said blade is adjustable radially with respect to said axis.

5. A cutting cylinder according to claim 1 or claim 4 wherein the distance of each said blade from said axis is adjustable, at each end thereof, independently of the other end, at least to a limited extent.

6. A cutting cylinder according to any of claims 1 or 3 to 5, wherein each said blade is a flat member cut from planar metal sheet.

7. A cutting cylinder according to any preceding claim wherein each said blade is mounted for limited radial movement with respect to said axis and is resiliently biased radially towards a predetermined position.

8. A cutting cylinder according to claim 1 wherein each said blade comprises two substantially planar portions bent at an angle with respect to each other about an imaginary line extending across the sheet metal of the blade, so that the blade is of chevron form, the apices of each of the chevron-shaped blades of the cylinder pointing in the same circumferential direction.

9. A cutting cylinder according to claim 2 which includes blades which are permanently fixed to said central structure in addition to blades which are detachably secured to said central structure.

10. A cutting cylinder according to claim 9, which has an even number of blades and wherein the permanently fixed and the detachable blades are disposed alternately around the circumference of the cylinder.

11. A mower incorporating a cutting cylinder according to claim 1.

12. A mower cylinder substantially as hereinbefore described with reference to, and as shown in, Figures 1 to 5 of the accompanying drawings.

13. A mower cylinder substantially as hereinbefore described with reference to, and as shown, Figures 6 to 9 of the accompanying drawings.

14. A mower cylinder substantially as hereinbefore described with reference to, and as shown in, Figures 10 and 11 of the accompanying drawings.

15. A mower cylinder substantially as hereinbefore described with reference to, and as shown in, Figures 12 and 13 of the accompanying drawings.

16. A mower substantially as hereinbefore described with reference to, and as shown in, Figures 14 and 15 of the accompanying drawings.

Fig.1.

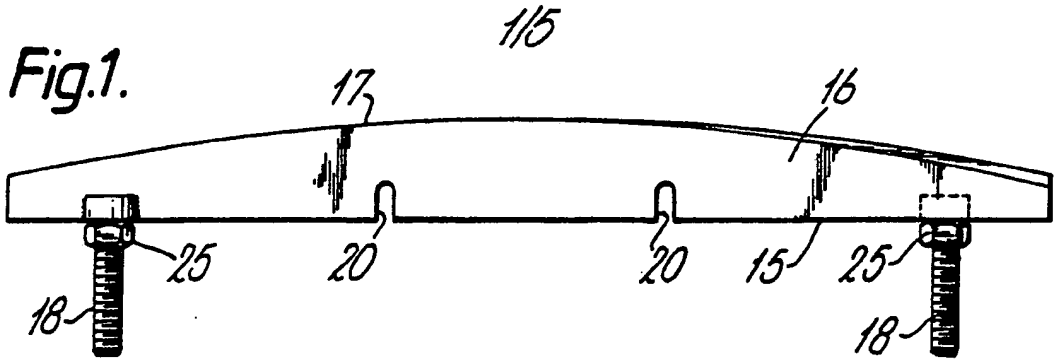


Fig.2.

Fig.4.

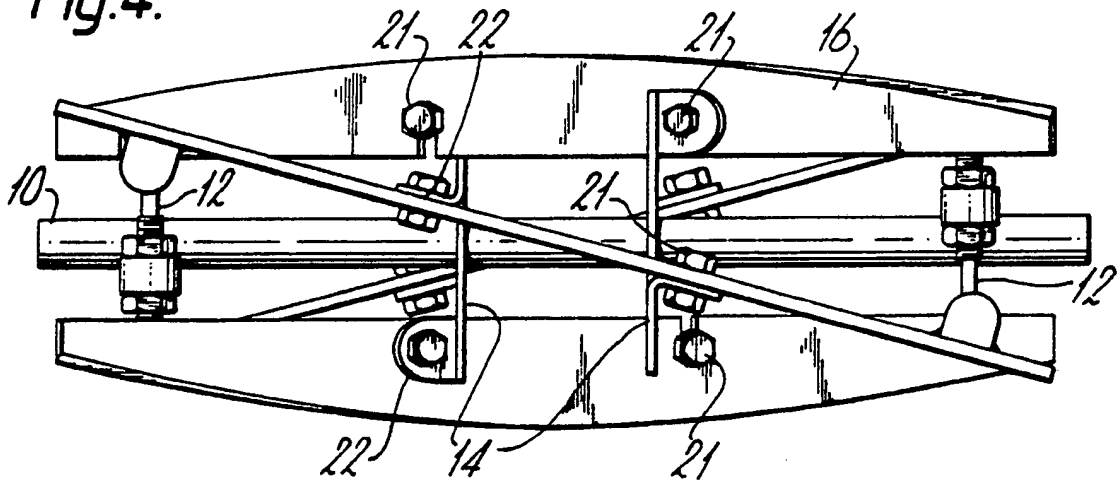


Fig.3.

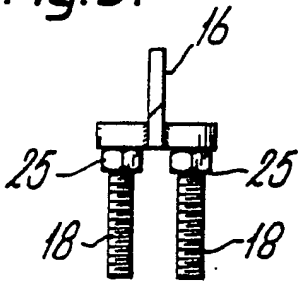


Fig.5.

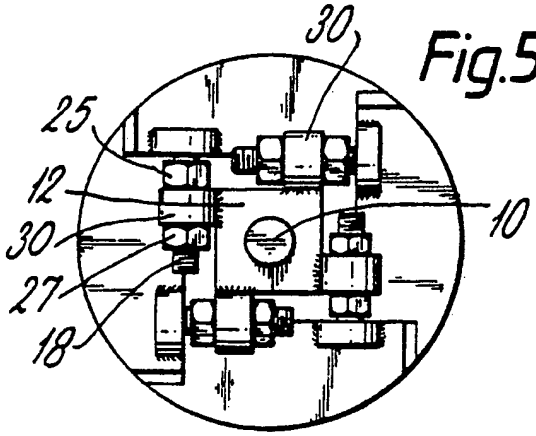


Fig.6.

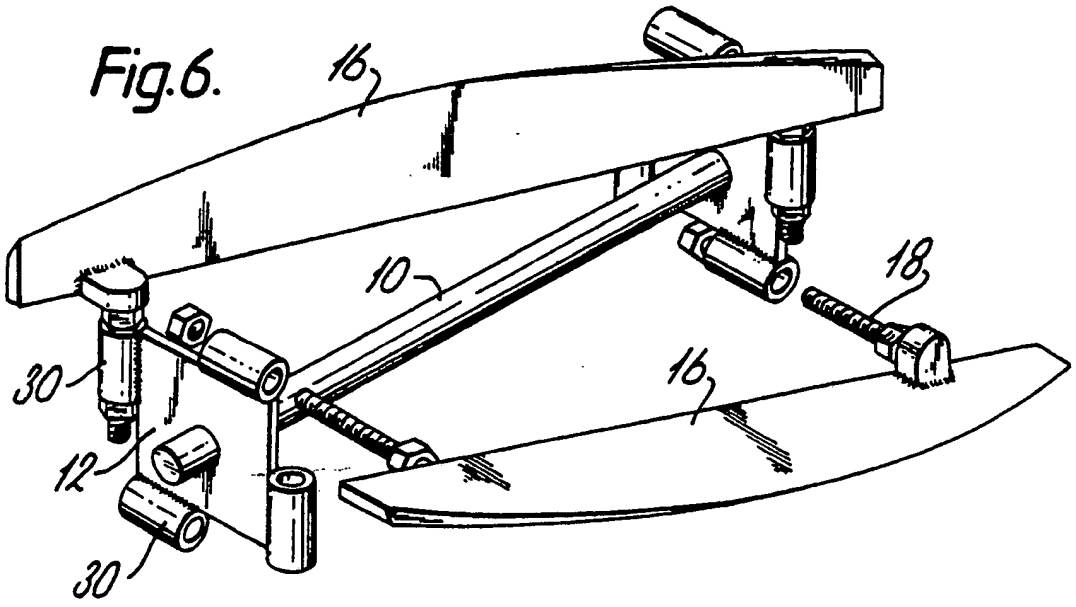


Fig.7.

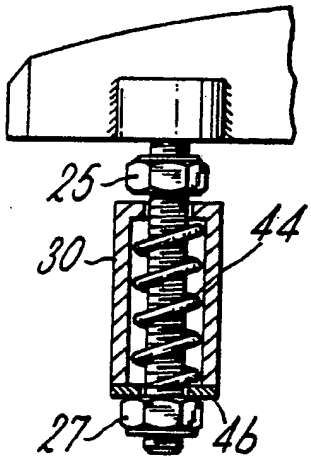


Fig.8.

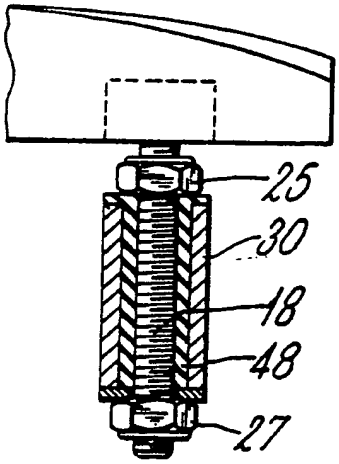


Fig.9.

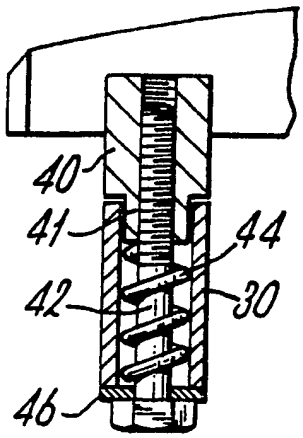


Fig.10.

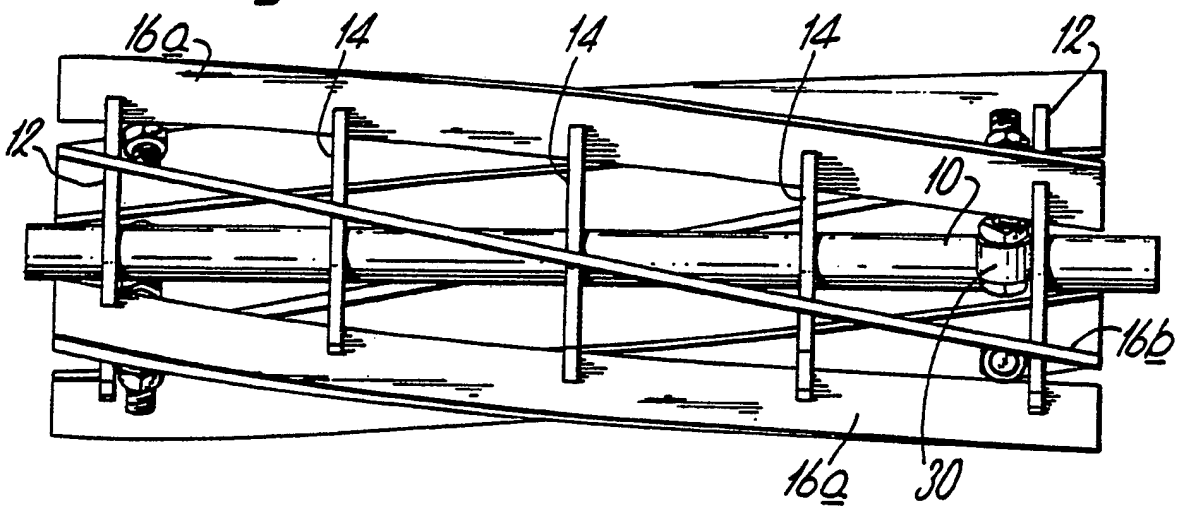


Fig.11.

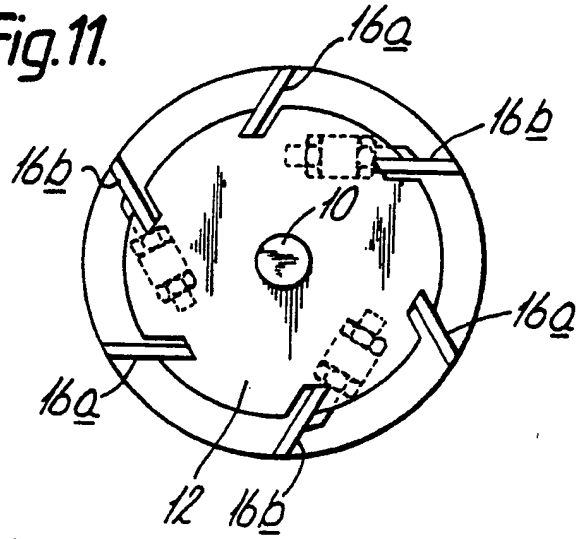


Fig.12.

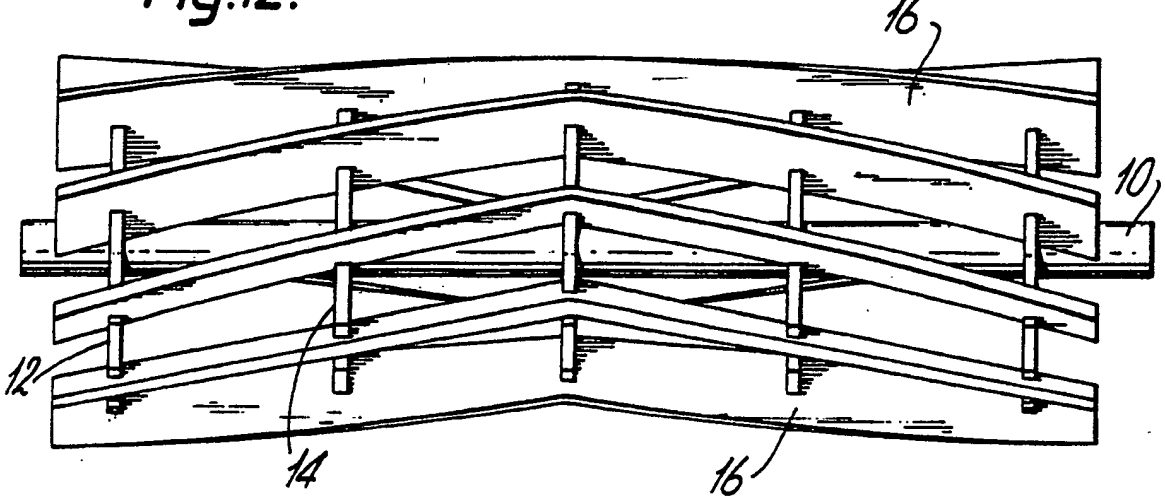
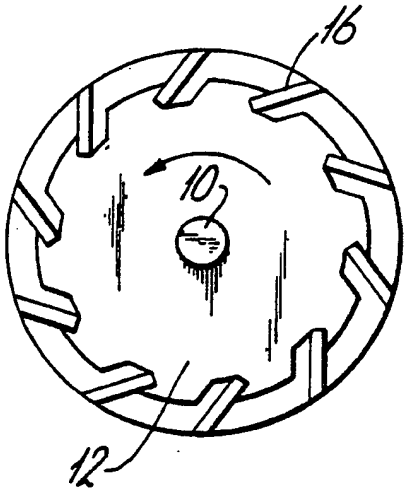


Fig.13.



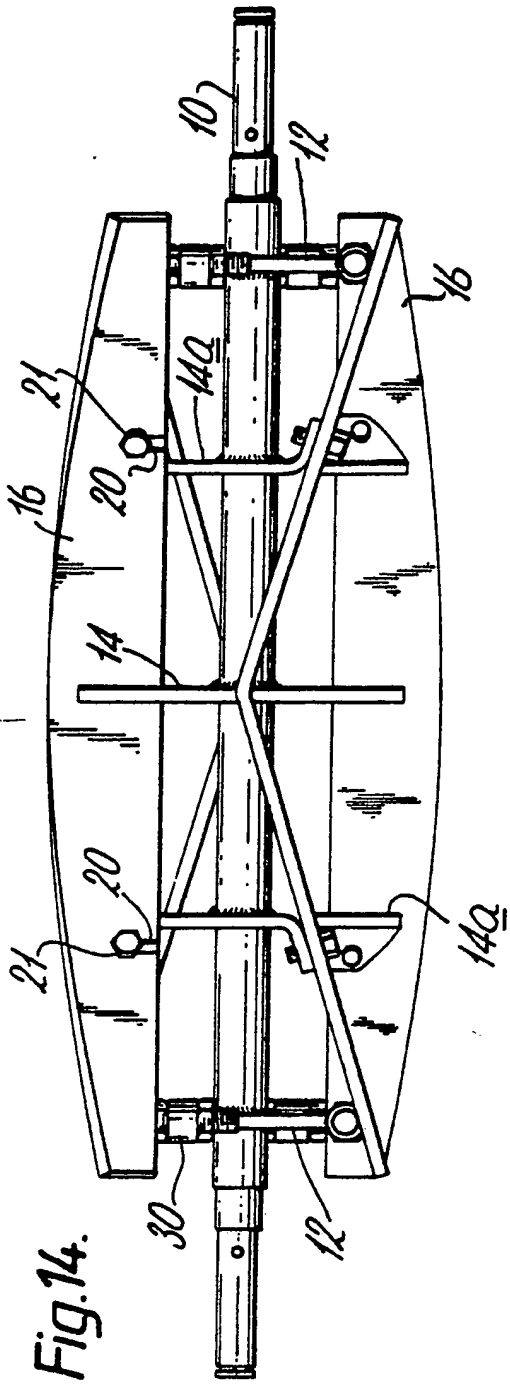


Fig.14.

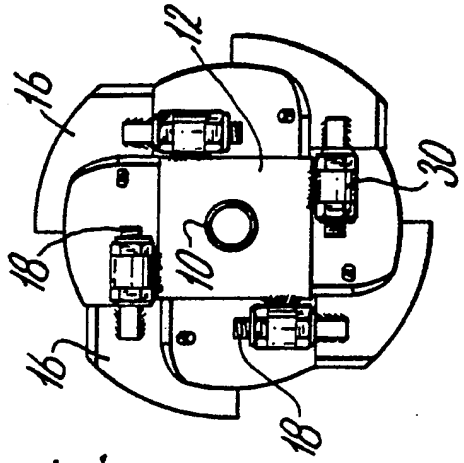


Fig.15.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 85/00217

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: A 01 D 34/52; A 01 F 29/20

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	A 01 D A 01 F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 2829693 (JARVIS) 8 April 1958, see column 2, lines 42-46; column 3, lines 34-60; claims 1-3; figures 3-5	1-6
X	FR, A, 2287842 (DEERE S.A.) 14 May 1976, see page 1, lines 35-40; page 4, lines 5-12; page 5, line 36- page 6, line 3; claims 2,3; figures 1,2,6	1-4,6,8
X	DE, C, 929823 (RITSCHER) 8 June 1955, see columns 3,5,6; figures 4-6	1,6,7,11
X	DE, B, 1204872 (JOHN DEERE) 11 November 1965, see column 4, lines 8-36, lines 44-65; figures 5,6	1,3,6,2,9,10
X	US, A, 3874605 (FLEMING) 1 April 1975, see column 2, lines 17-65; figure 2	2
A		3,6
A	GB, A, 251218 (MORGAN) 17 June 1926, see page 1, lines 57-80; claim 1; figure 2	8

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
16th July 1985	20 AOUT 1985
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	G.L.M. Kruydenberg

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 85/00217 (SA 9649)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/08/85

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 2829693		None	
FR-A- 2287842	14/05/76	US-A- 3974970	17/08/76
		GB-A- 1523894	06/09/78
		CA-A- 1034845	18/07/78
DE-C- 929823		None	
DE-B- 1204872		None	
US-A- 3874605	01/04/75	None	
GB-A- 251218		None	